US EPA Mid-Continent Ecology Division

Research Project Summary

Development of Diagnostic Community- to Landscape-scale Exposure and Response Indicators for Nutrient, Clean Sediment, and Habitat Alteration Stressors Impacting Lake Michigan Coastal Wetlands

Overview

This research is designed to enhance the existing Region 5 Great Lakes Coastal Wetlands Regional Environmental Management and Assessment (REMAP) project (Simon et al. 1999) and to extend the general approach of the Comparative Watershed Project (Detenbeck et al. 1997). The Region 5 REMAP project has two phases: 1) to compare proposed bioindicators and reference condition for macrophyte, macroinvertebrate, and fish communities in Lake Michigan coastal wetlands between northern and southern climatic provinces for a single wetland type (riverine coastal wetlands); and 2) to develop fish indices of biotic integrity (IBIs) across a range of coastal wetland types in four of the Great Lakes (Superior, Michigan, Huron, and Erie; Fig. 1).

Stage I of MED-Duluth research is designed to evaluate watershed-scale indicators of impairment to support diagnostics, to support wetland nutrient and clean sediment criteria through development of stressor-response relationships and evaluation of potential exposure metrics/indicators, and to provide exposure data to facilitate calibration of wetland biocriteria being developed under Region 5's coastal wetlands REMAP project. Stage II of MED-Duluth research is designed to use stable isotope analysis to examine potential changes in food web structure as nutrient loading to coastal wetlands increases.

Changes in watershed characteristics, either the loss of watershed storage or a conversion of native land cover (forest, grassland) to urban or agricultural land-use, is expected to result in an increase in flashiness of tributary hydrologic regimes and attendant sediment and nutrient loadings. We are developing watershed-scale indicators for the Great Lakes basin to predict different types of flow regimes, e.g., stable versus flashy riverine discharge (Fig. 2). Our hypothesis is that coastal wetlands associated with different flow regimes will have differential sensitivity to gradients of land-use and nutrient loading (Fig. 3). In the future, these watershed classes can be used as the basis for monitoring frameworks, to aid in diagnosing causes of impairment of coastal systems, and as a basis for predicting where and how watershed restoration should occur to protect coastal riverine wetlands.

EPA has requested that States and Tribes develop nutrient criteria for all water bodies, including wetlands. However, there are very few background data on nutrient levels in wetlands, or information on the response of wetlands to nutrient loading. Stage I of our research is designed to test many of the specific indicators of nutrient exposure and response in Great Lakes coastal riverine wetlands proposed for adoption by the States in their monitoring programs (see: http://www.epa.gov/waterscience/criteria/wetlands/). We are examining different indicators of nutrient exposure, including nutrient concentrations in the water column, sediments, and plant tissues. We are also testing various indicators of ecological response to nutrients, including enzyme activity in the sediments, process rates, community composition, and food web structure, by examining their response along gradients of nutrient loading (Fig. 4).

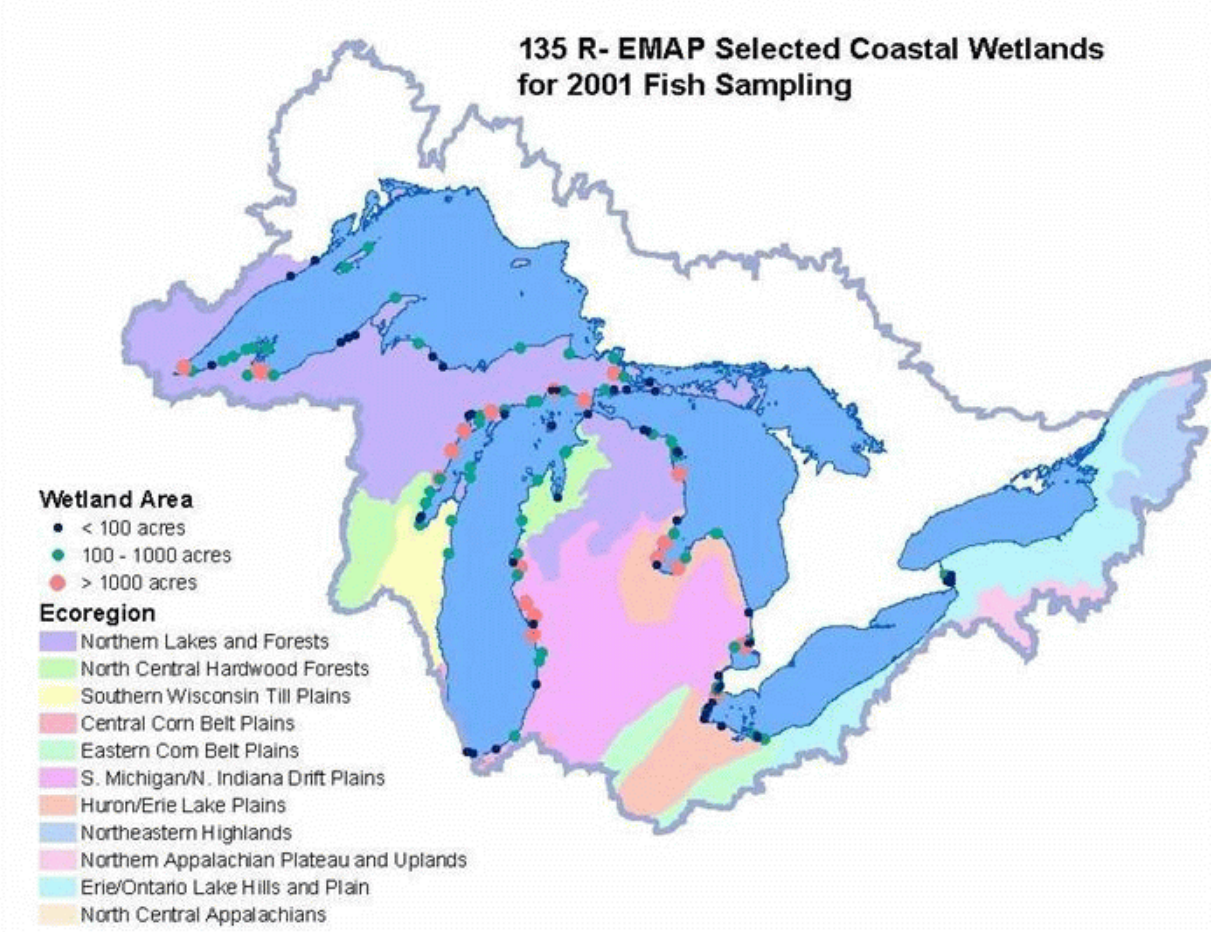
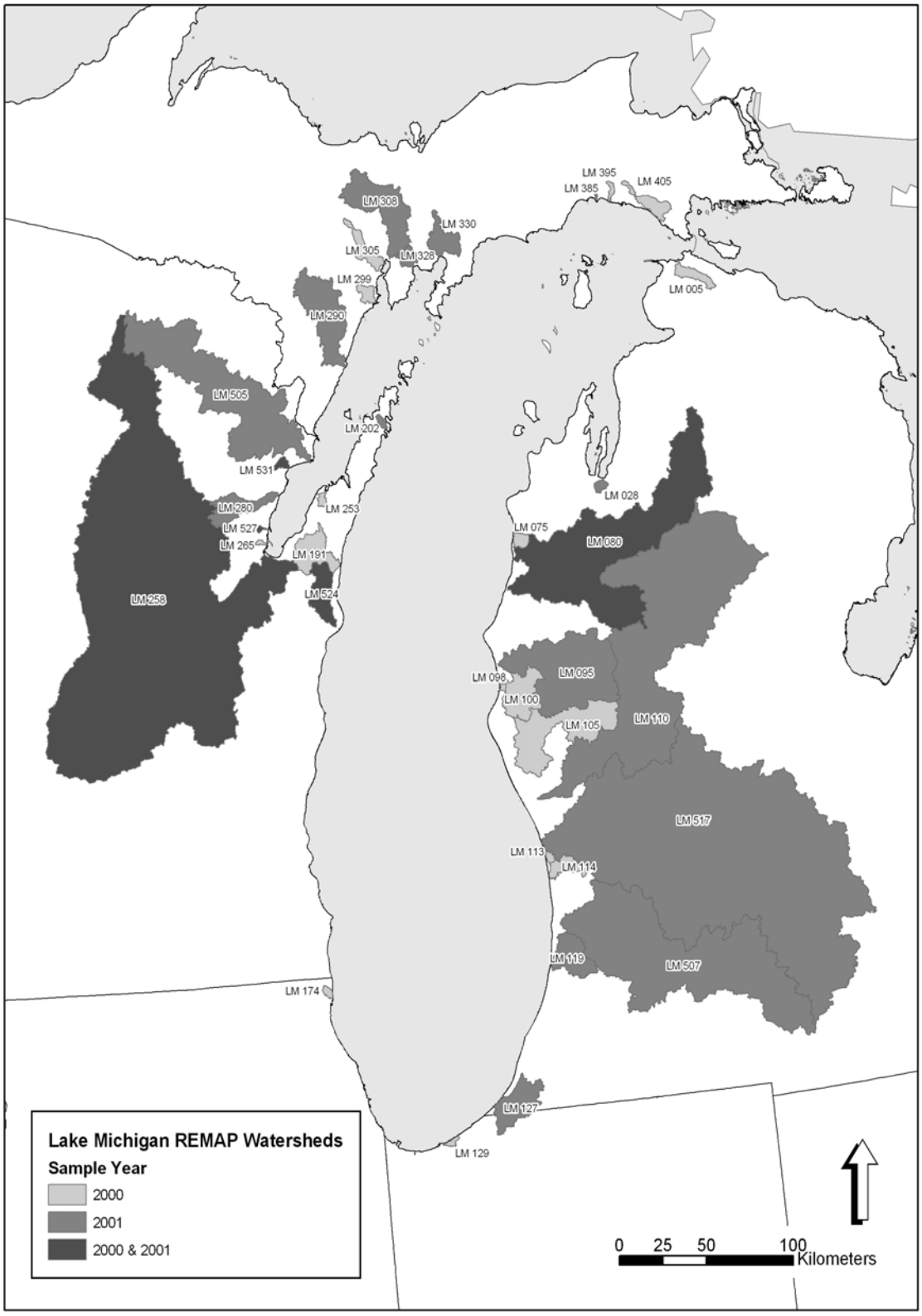

135 R- EMAP Selected Coastal Wetlands
for 2001 Fish Sampling
Wetland Area
< 100 acres
100 - 1000 acres
> 1000 acres
Ecoregion
Northern Lakes and Forests
North Central Hardwood Forests
Southern Wisconsin Till Plains
Central Corn Belt Plains
Eastern Corn Belt Plains
S. Michigan/N. Indiana Drift Plains
Huron/Erie Lake Plains
Northeastern Highlands
Northern Appalachian Plateau and Uplands
Erie/Ontario Lake Hills and Plain
North Central Appalachians

Figure 1


LM 395
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LM 265
LM 191
LM 089
LM 258
LM 524
LM 095
LM 098
LM 100
LM 110
LM 105
LM 517
LM 113
LM 114
LM 119
LM 507
LM 174
LM 127
LM 129
Lake Michigan REMAP Watersheds
Sample Year
2000
2001
2000 & 2001
0 25 50 100
Kilometers

Figure 2

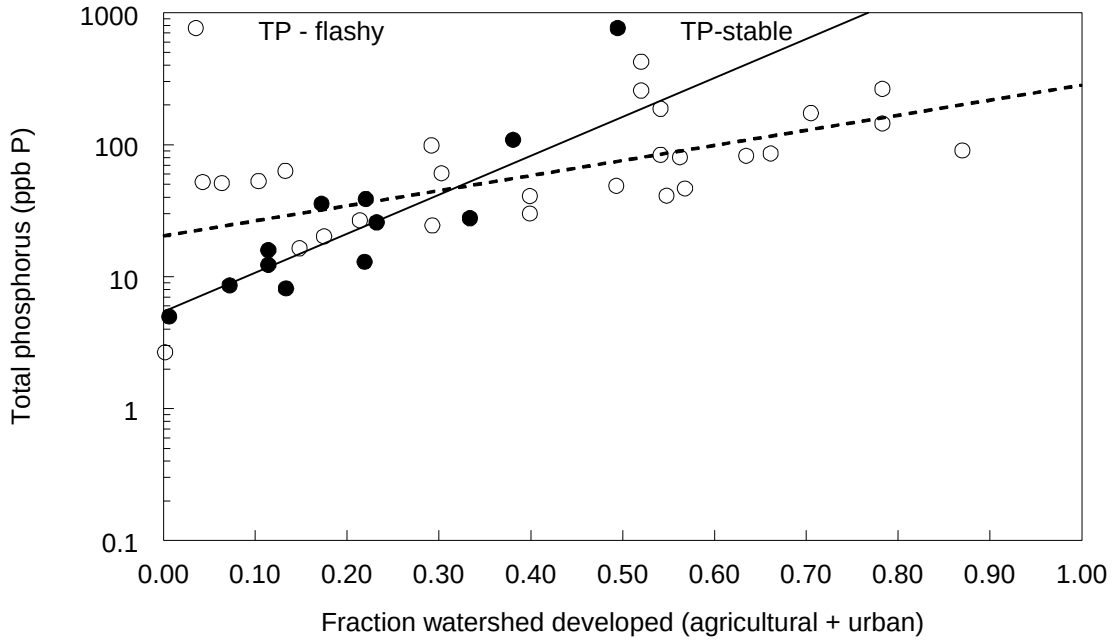
TP - flashy
TP-stable
Total phosphorus (ppb P)
1000
100
10
1
0.1
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Fraction watershed developed (agricultural + urban)

Figure 3

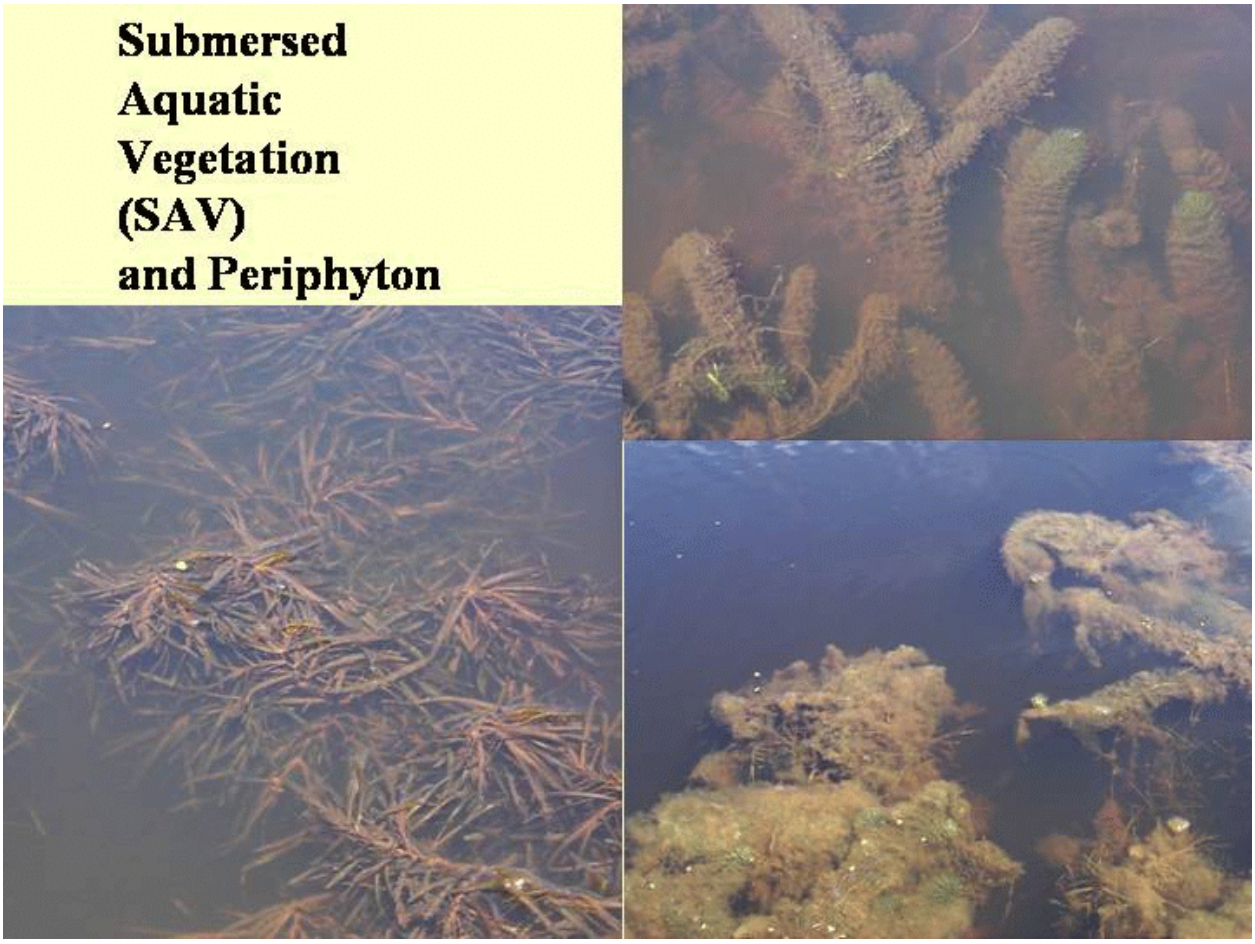

Figure 4

Key Products

Simon TP, Dufour RL, Stewart PM, and Moffett MF. 2003. Distribution, Classification, and Selection Rationale of Coastal Wetlands in Lake Michigan, IN: (T. Edsall et al., editors), The Lake Michigan Ecosystem: Ecology, Health, and Management. Elsevier Press, London, England.

Detenbeck NE, Moffett MF, Pearson MS, Simon TP, and Albert D. 2003. Flow- and nutrient-based classification of Lake Michigan coastal riverine wetlands. In review. To be submitted as invited chapter for Coastal Wetlands of the Laurentian Great Lakes, (T.P. Simon and P.M. Stewart, editors), CRC Press.

Detenbeck NE, Moffett MF, Jicha TM, Elonen CM, Anderson LE, and Taylor DL. 2003. Nutrient status of Lake Michigan coastal riverine wetlands. (To be submitted)

Moffett MF and Pearson MS. Food-web analysis using stable isotopes as a tool for assessment of ecological condition in Great Lake coastal wetlands. (In preparation)

http://www.epa.gov/emap/remap/html/five/index.html

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